



INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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(60) Parent Application or Grant NOR.WEB DPL LIMITED [/]; (.) BROWN, Paul, Anthony [/]; (.) SUMMERSCALES, Brian [/]; (.) BROWN, Paul, Anthony [/]; (.) SUMMERSCALES, Brian [/]; (.) HACKNEY, Nigel, J. ; (.)			
(54) Title: COUPLING APPARATUS AND METHOD			
(54) Titre: APPAREIL ET PROCEDE DE COUPLAGE			
(57) Abstract			
<p>The present invention relates to coupling apparatus for fitting to a conductor or cable. In particular, it refers to high frequency coupling apparatus suitable for telecommunications signals propagated, at least in part, along conventional power distribution cables. Accordingly, in a first aspect, the present invention provides a coupling apparatus suitable for coupling with an electricity cable (2), where the cable includes an electrically insulated conducting member (1), where the coupling apparatus includes cable insulation penetration means (3) for penetrating the electricity cable to provide an electrical connection to the conducting member, the penetration means (3) being electrically connected to a coupling member (5) suitable for connection to a telecommunications signal source or receiver. In this way, a coupling member suitable for connection to a telecommunications signal source or receiver may be electrically connected to the conducting core of a power cable or other type of conductor.</p>			
(57) Abrégé			
<p>L'invention concerne un appareil de raccordement destiné à être couplé à un conducteur ou un câble et, plus particulièrement, un appareil de raccordement haute fréquence approprié pour des signaux de télécommunication diffusés, au moins partiellement, par des câbles de distribution de puissance. En conséquence, dans un premier aspect, l'invention concerne un appareil de raccordement conçu pour être couplé à un câble électrique (2), qui comporte un élément conducteur isolé électriquement (1). L'appareil de raccordement comporte un dispositif de pénétration d'isolation (3) du câble destiné à pénétrer le câble électrique afin d'établir une connexion électrique avec l'élément conducteur, le dispositif de pénétration (3) étant électriquement connecté à un élément de raccordement (5) conçu pour être connecté à une source ou à un récepteur de signaux de télécommunication. De cette manière, un élément de raccordement conçu pour être connecté à une source ou à un récepteur de signaux de télécommunication peut être électriquement connecté au noyau conducteur d'un câble de puissance ou à un autre type de conducteur.</p>			

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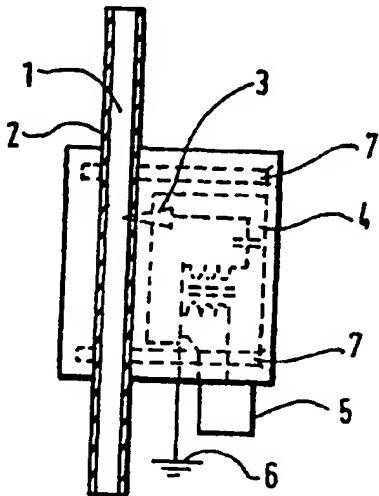
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(54) Title: COUPLING APPARATUS AND METHOD

(57) Abstract

The present invention relates to coupling apparatus for fitting to a conductor or cable. In particular, it refers to high frequency coupling apparatus suitable for telecommunications signals propagated, at least in part, along conventional power distribution cables. Accordingly, in a first aspect, the present invention provides a coupling apparatus suitable for coupling with an electricity cable (2), where the cable includes an electrically insulated conducting member (1), where the coupling apparatus includes cable insulation penetration means (3) for penetrating the electricity cable to provide an electrical connection to the conducting member, the penetration means (3) being electrically connected to a coupling member (5) suitable for connection to a telecommunications signal source or receiver. In this way, a coupling member suitable for connection to a telecommunications signal source or receiver may be electrically connected to the conducting core of a power cable or other type of conductor.



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Description

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COUPLING APPARATUS AND METHOD

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The present invention relates to coupling apparatus for fitting to a conductor or cable. In particular, it 15 refers to high frequency coupling apparatus suitable for telecommunications signals propagated, at least in part, 20 along conventional power distribution cables.

25 The transfer of communication signals along electricity 10 distribution and/or transmission networks is a promising development in the telecommunications industry. The 30 communication signals may be transferred even whilst the power cables/conductors are energized.

35

15 Various technical aspects of systems whereby 40 telecommunications signals can be conveyed along an electricity distribution and/or transmission network are disclosed in published patent applications of the present 45 applicant. These applications include the following: 20 WO94/09572, WO95/29572, WO95/29537, WO96/07245, WO98/19398, the disclosures of which are incorporated 50 herein by reference.

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It is desirable that the coupling of telecommunication signals onto power distribution and/or transmission networks be achieved in a safe, efficient and cost-effective way.

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The present invention aims to provide a method and apparatus for effectively coupling communication signals onto and off an existing, possibly energized, mains electricity distribution and/or transmission network.

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Accordingly, in a first aspect, the present invention provides a coupling apparatus suitable for coupling with an electricity cable, where the cable includes an electrically insulated conducting member, where the 35 15 coupling apparatus includes cable insulation penetration means for penetrating the electricity cable to provide an electrical connection to the conducting member, the penetration means being electrically connected to a coupling member suitable for connection to a 40 20 telecommunications signal source or receiver.

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In this way, a coupling member suitable for connection to

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10 a telecommunications signal source or receiver may be
electrically connected to the conducting core of a power
cable or other type of conductor.

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5 Thus the coupling device could be retro-fitted to an
existing power distribution and/or transmission network.

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To minimize disruption to consumers' power supplies and
to avoid time-consuming installation, preferably the
coupling device should be adapted to be fitted to, for
25 example, an insulated power cable without disconnecting
that power cable from the power source, i.e. while the
cable is "energized" or live.

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35 The coupling member is electrically isolated at low
15 frequencies (e.g. 50/60 Hz or possibly up to 100 or 200
Hz) from the insulation penetration means using a low
40 frequency protection means such as a high pass filter,
for example a suitable capacitor. Furthermore, the
coupling member may be electrically protected from the
45 20 cable insulation protection means by, for example a fuse
and/or transformer, e.g. a balun transformer.

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10 The insulation penetration means is adapted to pierce a
sleeve of electrical insulation material around the power
cable or conductor and hence come into and establish
electrical contact with the electrical current carrying
15 5 part of the conductor. In this way, the coupling device
is suitable for attachment to a power cable or conductor
20 at many different places along the cable or conductor
length.

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10 In some instances, it might not be desirable for the
electronic components to be attached to the cable at all
30 times. Accordingly, in a second aspect, the present
invention provides a coupling device including a clamp
35 and a clamp head. The clamp includes the insulation
15 penetration means and means for fitting the insulation
penetration means to the cable. The clamp head includes
40 a coupling member suitable for connection to a
telecommunications signal source or receiver. The
coupling member is preferably protected by low frequency
45 20 protection means such as a high pass filter, for example
a suitable capacitor. Furthermore, the coupling member
50 may be electrically protected from the cable insulation

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penetration means by, for example, a fuse and/or balun
10 transformer.

15 In a preferred embodiment of the present invention, one
5 end of the primary winding and/or one end of the
secondary winding of the transformer is/are electrically
20 bonded to an earth potential. Furthermore, in another
preferred embodiment, one end of both the primary and
secondary windings of the transformer are electrically
25 bonded to the same earth potential.
10

30 In another preferred embodiment of the present invention,
the cable insulation means includes a spike.
35 Additionally or alternatively, this spike may be rigid.
15 Additionally or alternatively, the spike may be
40 electrically conducting. Additionally or alternatively,
there may be a plurality of spikes, preferably spaced 0.5
45 - 1.5cm apart, most preferably around 1cm apart.

45 20 Preferably, the present invention includes clamping means
50 for urging the penetration means into the cable the
clamping means may include a screw operated compression

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member.

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Preferably, the present invention includes a housing which, in use, fits around the cable.

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In another preferred embodiment of the present invention, the coupling apparatus includes a two part housing, the first part containing the coupling member and the second part containing the penetration means wherein the two parts are releasably joined together. Preferably, the clamping means is included in the second part of the housing.

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Preferably, the cable insulation penetration means and the coupling member are electrically connected via a conducting spring.

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Embodiments of the present invention will now be described with reference to the accompanying drawings in which:-

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Figure 1 is a schematic diagram of a coupling device

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10 according to a first embodiment in which the main internal components are illustrated.

15 Figure 2 is an exploded schematic diagram of a coupling
5 device according to the first embodiment, showing the
device in its two main component pieces.

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25 Figure 3 is an exploded schematic diagram of a coupling
device according to the first embodiment, corresponding
10 to a section viewed in a plane which is perpendicular to
the axis of the cable at the line marked "X-X" in Figure
30 2.

35 Figure 4 is a schematic diagram of a coupling device
15 according to a second embodiment in which the main
internal components are illustrated.

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45 Figure 5 is an exploded schematic diagram of a coupling
device according to the second embodiment, showing the
20 device in its three main component pieces.

50 Figure 6a is a side view of a coupling device according

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to a further embodiment of the present invention;

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Figure 6b is an end view of the device of Figure 6a;

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5 Figure 7a is a side view of a further embodiment of a coupling device according to the present invention; and

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Figure 7b is an end view of the device of Figure 7a.

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10 Figures 1, 2 and 3 show a coupling device according to the first embodiment of the present invention. The unit consists of two parts 21 and 22, constructed in part using a strong, non-conducting material, which are clamped tightly together using, for example, two screws

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35 15 The device is preferably clamped across an insulated power cable 2. The outline of the unit is preferably shaped to fit an insulated cable 2 between the two parts of the coupling device 21 and 22. For example, the outline of the coupling device is concave, as shown in

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45 20 Figure 3. The insulation penetration means preferably includes a rigid conducting spike 3. This spike protrudes a pre-set distance into the concave outline of

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the unit. The insulation 8 is pierced and electrical contact is made between the rigid conducting spike 3 and the metallic power conductor 1 as the clamping screws 7 are tightened.

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The rigid conducting spike 3 is electrically connected to a circuit 4, schematically shown in Figure 1. This circuit preferentially includes one or more protection devices such as a fuse and a balun transformer. The circuit further includes a low frequency protection device such as a high pass filter for the high frequency communication signals, for example a suitable capacitor. The circuit is provided with a coupling member such as a communications signal input/output port, typically a coaxial, unbalanced, high frequency, standard BNC connector 5 well known in the art. Preferably, a safety earth is attached via 6 in Figure 1. Additionally or alternatively an isolation capacitor may be included on the "braid" side of the coaxial connector 5 in order to isolate it from the mains electricity supply in the event of a fault.

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10 In this first embodiment, the circuit 4 is entirely contained within the insulating casing of the device. Therefore, during installation of the coupling device, no 'live' conducting elements are exposed, either on the 15 5 cable or on the device itself.

20 Figures 4 and 5 illustrate a coupling device according to a second embodiment of the present invention. The device is constructed in part using a strong, non-conducting 25 10 material and is made up of three main parts 51, 52 and 53. Main parts 51 and 52 are shaped, for example in a 30 concave sense, so that an insulated cable 31 may fit between them in a similar sense to the first embodiment, shown in Figure 3. Parts 51 and 52 may be clamped 35 15 tightly together using a single screw 40. A rigid 40 conducting spike 34, similar to a spike 3 in the first embodiment, protrudes a pre-set distance into the concave outline of part 52. The insulation 42 is pierced and 45 20 electrical contact is made between the rigid conducting spike 34 and the metallic power conductor 32 as the clamping screw 40 is tightened.

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The rigid conducting spike may be electrically connected to a fuse carrier and link 36 via a conducting spring 35 when the clamp 33, made up using main parts 51 and 52, is attached to a clamp head 37 (or 53) via screws 41. The 10 5 clamp head contains a circuit 36, preferentially including protection devices such as a fuse and a balun 15 transformer. The circuit further includes a low 20 frequency protection device such as a high pass filter 25 for high frequency communication signals and is similar 30 10 to the circuit 4 described in outline in the first embodiment of the invention. The circuit 36 is provided with a coupling member such as a communications signal 35 15 input/output port, typically a coaxial, unbalanced, high frequency, standard BNC connector 38 well known in the art. Preferably, a safety earth is attached via 39.

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The second embodiment of the present invention allows the clamp head 53 to be easily removed from the cable clamp 51 and 52 whilst, if desired, leaving the cable clamp 51 45 20 and 52 still attached to the cable. The cable clamp may then be covered using a fascia plate. This removes the 50 need to place an insulating sleeve over the puncture hole

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in the cable insulation if it is required to remove the
10 coupling device from the cable at some later date.

15 The embodiment of the invention shown in Figures 6a and
5 6b consists principally of a first part 60 of the
coupling unit and a saddle 61. As will be seen, the
20 saddle 61 sits on top of the coupling unit part 60. The
saddle may, for example, be made of steel and may be
25 around 20 x 30 x 3mm in size including a tapped hole for
10 receipt of a screw 62, with for example a 5mm thread.

30 In use, the unit 60 is placed against an insulated cable
63 to a conductor of which contact is required to be
made. Initially, the saddle lies against or adjacent the
35 15 top of the part 60 as shown in Figure 6a. The contacts
(not shown) project against the cable 63.

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45 One or more cable ties 64 (in this embodiment, two ties
20 are used) secure the unit 60 against the cable 63. In
this embodiment each of the cable ties 64 is located on
50 a respective side of the screw 62 and also serve to hold
the saddle against the unit 60. As will be seen more

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clearly in Figure 6b, the eye 65 of each cable tie abuts
10 against a square edge 66 of the saddle 61. By contrast,
the edge 67 of the saddle 61 over which the elongate
15 portion of the cable tie 64 lies is rounded so as to
5 relieve the stress on the cable tie. Also optionally
provided are locating notches in the saddle 61 (not
20 shown) which serve to locate the elongate portion of the
cable ties 64. In some embodiments, the rounded edges
mentioned previously may only be provided in the locating
25
10 notches.

30 Once the cable ties have been tightened as much as
possible by hand in the conventional manner, the machine
screw 62 may then be operated (in this case turned
35 15 clockwise) so that its end moves against the top of the
unit 60 and forces the saddle 61 away from the unit 60.
40 This action serves to drive the electrical connection
spikes through the installation cable 63. As will be
apparent to the skilled person, means other than the
45 20 screw 62 may be provided to perform this same function.

50 Figures 7a and 7b show a further embodiment of the

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present invention which is similar to the embodiment of
10 Figures 6a and 6b with the exception that the saddle is
omitted. The cable tie locating notches may instead be
formed directly in an upper edge 70 of the unit 71.

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5 Means are provided inside the unit 71 (not shown) for
moving the tips of the electrical connection spikes in a
20 direction away from the unit 71 so that, in use, the
spikes extend further towards the cable 72. These means
are operable by, in this example, rotation of a rod head
25 10 73 which is located on the top surface of the unit 71.
Naturally other means for operating the spike driving
30 means will be apparent to the skilled person and may be
used instead.

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15 In use, the unit 71 is placed adjacent the cable 72 and
the cable ties 74 are tightened by hand as previously.
40 The rod 73 (which may be made of nylon of, for example a
millimetre diameter) is then operated (e.g. turned
clockwise) to drive the contact spike(s) out of the base
45 20 of the coupler into the cable thereby tensioning the
cable ties and piercing the cable insulation to make
50 contact with the conductor.

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In either of the embodiments of Figure 6 or Figure 7, or
10 indeed in any of the embodiments described previously,
the base 68, 78 of the unit 60, 71 may be shaped
differently to that shown in the drawings. In a
15 5 preferred embodiment, the base 68, 78 may be shaped so as
to conform more closely to the surface shape of the cable
20 which, in this example, is roughly circular. This
enables the unit 60, 71 to be more easily located against
the cable.

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Each of the embodiments of the present invention
30 described above may be self supporting in that they are
supported only by the cable to which they are clamped.
A further embodiment of the invention includes having one
35 15 or more lugs attached to the clamp devices. In this way,
the clamps themselves may be attached to a suitable
40 surface.

45 Furthermore, the embodiments described above are also
20 suitable for coupling communications signals to/from
cables with more than one conducting core. In this way,
50 a range of, for example differential, phase to phase,

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phase to neutral/earth, phase to earth, neutral to earth
10 or polyphase modes of high frequency signal coupling may
be provided.

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5 As will be appreciated, the above embodiments are given
by way of example only and modifications will be apparent
20 to those skilled in the art.

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Claims

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CLAIMS

15 1. A coupling apparatus suitable for coupling with an
5 electrically insulated conducting member, where the
coupling apparatus includes cable insulation
20 penetration means for penetrating the electricity
cable to provide an electrical connection to the
conducting member, the penetration means being
25 electrically connected to a coupling member suitable
10 for connection to a telecommunications signal source
30 or receiver.

35 2. A coupling apparatus according to any one of the
15 above claims including a clamp and a clamp head,
40 wherein the clamp includes the insulation
penetration means and means for fitting the
insulation penetration means to the cable, and the
45 clamp head includes the coupling member.

45 20 3. A coupling apparatus according to claim 1 including
50 low frequency protection means for electrically

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isolating the coupling member at low frequencies
from the insulation penetration means.

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4. A coupling apparatus according to claim 1 or claim
5 including a fuse and/or transformer by which the
coupling member may be electrically protected from
the cable insulation protection means.

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5. A coupling apparatus according to claim 4 in which
10 one end of the primary winding and/or one end of the
secondary winding of the transformer is/are
electrically bonded to an earth potential.

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6. A coupling according to claim 5 in which one end of
15 both the primary and secondary windings of the
transformer are electrically bonded to the same
earth potential.

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7. A coupling apparatus according to any one of the
45 20 above claims wherein the cable insulation means
includes a spike.

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8. A coupling apparatus according to any one of the above claims including clamping means for urging the penetration means into the cable.

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5 9. A coupling apparatus according to any one of the above claims including a housing which, in use, fits around the cable.

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10. A coupling apparatus according to any one of the above claims wherein the cable insulation penetration means and the coupling member are electrically connected via a conducting spring.

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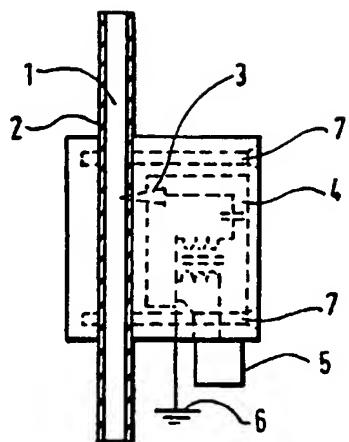


Fig.1.

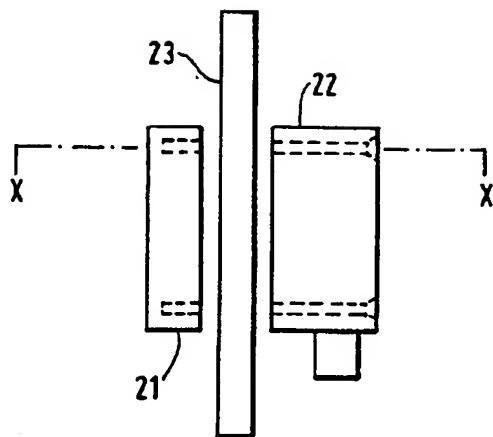


Fig.2.

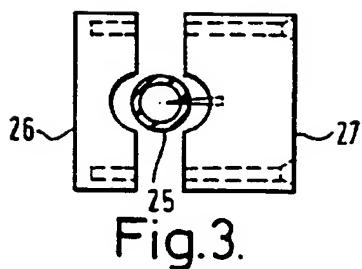


Fig.3.

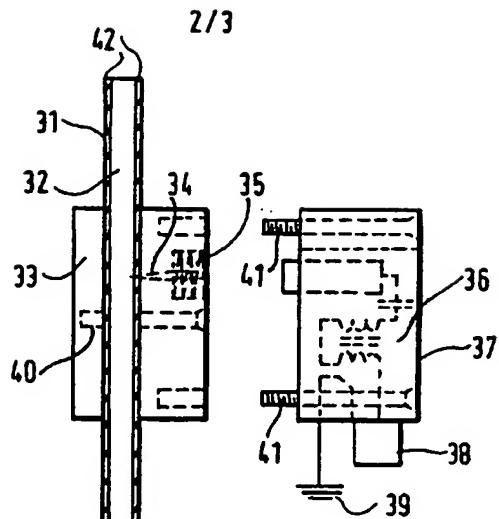


Fig.4.

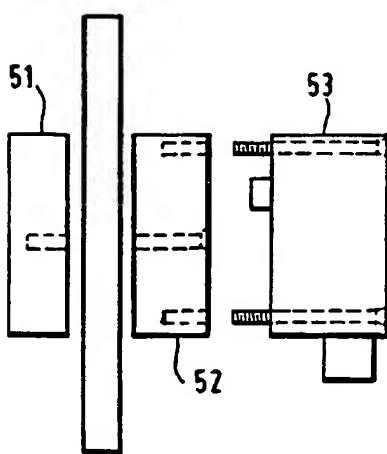


Fig.5.

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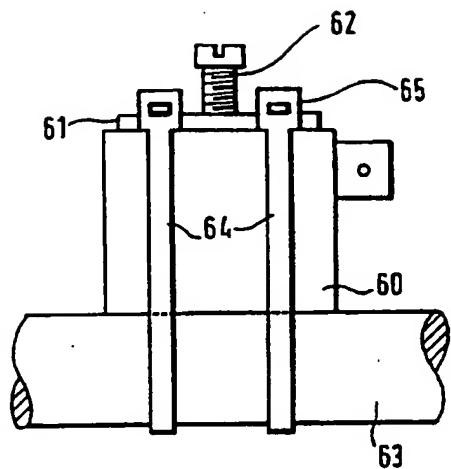


Fig.6a.

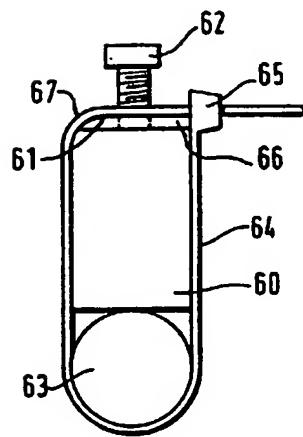


Fig.6b.

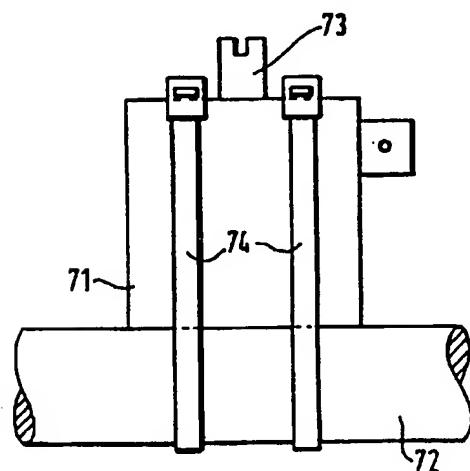


Fig.7a.

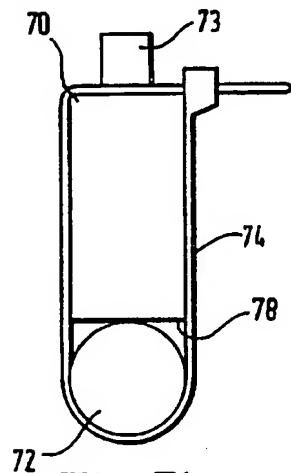


Fig.7b.

INTERNATIONAL SEARCH REPORT

International Application No
PCT/GB 00/01196

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 HO1R4/24

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

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IPC 7 HO1R

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C. DOCUMENTS CONSIDERED TO BE RELEVANT

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X	EP 0 283 012 A (SUMITOMO ELECTRIC INDUSTRIES) 21 September 1988 (1988-09-21) column 2, line 52 -column 4, line 38; figures 2,4,5	1,2,7-9
X	US 5 367 251 A (MCTIGUE JAMES F) 22 November 1994 (1994-11-22) column 5, line 20-68; figure 3	1,7-9
X	EP 0 471 630 A (GREILLIER BERNARD) 19 February 1992 (1992-02-19) column 3, line 14 -column 4, line 26 figures 2-4	1,8,9
X	WO 98 45896 A (WHITAKER CORP) 15 October 1998 (1998-10-15) claim 1; figures 1,3	1,8,9
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Date of the actual completion of the international search	Date of mailing of the international search report
8 June 2000	19/06/2000
Name and mailing address of the ISA European Patent Office, P.B. 5810 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040. Tx. 31 851 epo nl. Fax: (+31-70) 340-3016	Authorized officer Waern, G

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